

101900-44-L

18 December 1974

Developing Processing Techniques for Skylab Data
Monthly Progress Report November 1974

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EREP Investigation 456 M
NASA Contract NAS9-13280

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(E75-10082) DEVELOPING PROCESSING
TECHNIQUES FOR SKYLAB DATA Monthly Progress
Report, Nov. 1974 (Environmental Research
Inst. of Michigan) 5 p HC \$3.25 CSCI 05B

N75-15102

Unclas
G3/43 00082

Developing Processing Techniques for Skylab Data Monthly Progress Report, November 1974

The following report serves as the twenty first monthly progress report for EREP Investigation 456 M which is entitled "Developing Processing Techniques for Skylab Data". The financial report for this contract (NAS9-13280) is being submitted under separate cover.

The purpose of this investigation is to test information extraction techniques for SKYLAB S-192 data and compare with results obtained in applying these techniques to ERTS and aircraft scanner data.

On the last day of the reporting period we received our ordered SKYLAB S-192 scan line straightened data CCTs from Houston. Also, earlier in the month we received 9" images acquired by the S-190B device. We are now in receipt of all ordered SKYLAB data products and expect to begin processing of the data immediately.

The processing of the aircraft-acquired multispectral data continued during the month of November.

As previously indicated we had initially digitized one flight line of data. After digitization, the data were dynamically clamped to reduce low frequency noise in the data. During the reporting period we completed the preprocessing of the data by using the average signal versus angle data transformation [1]. In this method, for each channel, the average signal at each discrete scan angle (pixel) is calculated and the resulting function analyzed.

The average signal function in all channels was quadratic in form. The data were corrected by dividing the data values by the corresponding value of the correction function.

We began the initial analysis by calculating the marginal frequency distribution for each channel for the entire data set. The NSPACE algorithm is a well known technique in remote sensing and while we do not have a computer program for it, it was felt that here we could apply the principal manually. Consequently, each of the mfd's were carefully examined for modes. The result was, however, that each of the channels appeared to be unimodal -- no amount of scrutiny could find other lesser modes in the data.

Progressing from here, we obtained coordinates for training fields for 60 areas for five object classes: corn, soybeans, bare soil, water, and trees. The training fields were located in three groups: at the beginning, middle, and end of the 20 mile-long flight line. Statistical signatures were calculated for each of the 60 areas identified. Other extensive ground covers in the area included hay fields, pastures, alfalfa fields, farmsteads, and also bean and winter wheat fields where the crop had been harvested and the vegetation was in various stages of senescence.

Because of the wide field to field differences for these latter classes it was felt that simply selecting a small number of training sets might not work well. Instead, it was decided to use the ERIM cluster capability to calculate meaningful statistical signatures for these classes. Additionally, it is hoped that the cluster results will prove useful in refining the signatures for the five major classes referred to earlier.

The ERIM cluster program requires specification of three particular parameters which have to do with the structure of the data. The first is an estimate of the expected standard deviation in each channel of the final signatures. For this we used an average of the standard deviations from the calculated signatures. The second and third are thresholds to include or exclude a data point. These are defined as the distance in σ 's from a cluster centroid to the data point. After much experimentation, values of 4.0 and 5.0 were used.

Lastly, the present implementation of the ERIM cluster program is limited to using eight channels or less of data. As the aircraft data are 12 channel data, this necessitated the selection of a subset of channels. This was accomplished by graphing the mean $\pm 1\sigma$ of the signatures already calculated, and examining these plots for separability of object classes in each channel. The following table summarizes the results. Accordingly, it was decided to run cluster with a subset of seven channels: 2, 3, 7, 9, 10, 11, 12.

We plan to run the cluster program during the coming month and continue the analysis for the training procedure for this data set.

REFERENCE:

[1] Nalepka, R. F. and J. P. Morgenstern, Signature Extension, ERIM 31650-152-T, March 1973.

<u>SEPARABILITY</u>	<u>CHANNEL NUMBER</u>	<u>WAVEBAND (μm)</u>
Between all or most of the 5 object classes	9	.67 - .94
	10	1.0 - 1.4
	11	2.0 - 2.6
Between some of the 5 object classes	2	.46 - .49
	3	.48 - .52
	7	.58 - .64
	12	9.3 - 11.7
Poor, none, or in-class variations greater than between-class	1	.41 - .48
	4	.50 - .54
	5	.52 - .57
	6	.55 - .60
	8	.62 - .70

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